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To Whom It May Concern,

Computing and communications are becoming inextricably linked to our physical world. New consumer and industrial products include some form of computing to enhance functionality and to better control processes. For instance, modern cars would not be able to satisfy emission control requirements, would not be able to travel safely on slippery roads, and would not be able to inform the drivers about traffic congestion and alternative routes without embedded and networked computing devices. These *cyber-physical systems* that integrate the physical with the computational to provide new and improved functions are clearly at the forefront of technological development, and their quality, safety, and dependability is of utmost importance.

The electronics industry keeps coming up with new components (processors, networks, interfaces), but these devices are only enablers of new functions. To implement new functions (like stability control on cars) domain engineers from different disciplines, including mechanical engineering, electrical engineering, software engineering, and industrial engineering have to work together – in a truly interdisciplinary manner -- to build these systems. New aspects, like cybersecurity, human interfaces and cognition, and total energy management are being recognized as important factors for quality and dependability as well.

It seems that competitiveness in any industry that manufactures physical products (vehicles, consumer devices, healthcare equipment, etc.) depends on how well it can take advantage of the computational ('cyber') technology and can incorporate that into its products. However, the cyber-physical systems change the design paradigm: systems have to be created with deep understanding of the interdependencies between the physical and the computational. Designers have to be trained to follow a 'systems' thinking and understand the subtleties of cyber-physical systems, where computing and physics (and biology and chemistry and psychology and economy and so on) interact. We need new foundations for the science and engineering of cyber-physical systems that is applicable across many industries.

NITRD could play an essential coordinating role to make this happen. By providing coordination across government agencies, it is in a unique position to ensure that the science and engineering of cyber-physical systems becomes a reality, and that foundations developed are used in real, potentially societal-scale systems. The table below attempts to provide a partial list of that could play a specific role in CPS.

Agency	Potential topics the agency could support in a CPS effort
NSF	Fundamental science of cyber-physical systems Engineering foundations for systems integration; Education
NASA	Cyber-physical systems in the aerospace area
FAA	High-consequence and autonomous systems
NSA	Cybersecurity issues in CPS
DARPA/DoD	Defense applications; extreme-scale CPS
DOE	Energy systems as CPS
NIST	Joint academia-industry projects with engineering applications
NIH, FDA	Medical devices as CPS

One can envision multi-agency programs, where a specific *'grand challenge' problem* is defined, and teams that include participants from academia, industry, and government work on the problem in a competitive manner, are funded by various agencies, and solve basic science and engineering, as well as applied engineering problems.

An organization like NITRD could also foster *academia/industry partnerships*. For example, on a joint, academia/industry project the academic part could be funded by NSF, and the industrial part could be funded by NIST. The results that include academic results, but also prototype designs and implementations should be made 'open source', for public use.

NITRD could also help the coordination by providing a '*clearinghouse*' of CPS research results and application examples. Along the lines of the ESCHER effort a community of CPS researchers could be created that allows the rapid dissemination of results and tools.

Publicly funded R&D activities should be done in an open environment, with industry participation in a pre-competitive phase. Organizations that assist with the dissemination and rapid transitioning of the results of government investment should be supported. Past examples include: BSD Unix and ESCHER.